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OCTOBER 11-12, 1988

WORKSHOP ON ALTERNATIVE METHODS TO PURSE-SEINING FOR YELLOWFIN TUNAS IN THE EASTERN TROPICAL PACIFIC

Sponsored by:

NOAA's Fisheries Service
Department of Commerce

ADMINISTRATIVE REPORT LJ-89-06

This Administrative Report is issued as an informal document to ensure prompt dissemination of preliminary results, interim reports and special studies. We recommend that it not be abstracted or cited.

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WORKSHOP ON ALTERNATIVE METHODS TO PURSE-SEINING FOR YELLOWFIN TUNAS IN THE EASTERN TROPICAL PACIFIC

I. Introductory Remarks.

On 11-12 October 1988 a workshop was held in La Jolla, CA for the purpose of producing a clear and succinct description of what information or research is needed to evaluate the potential utility of various alternatives to purse-seine fishing for yellowfin tuna in the eastern tropical Pacific (ETP) that will reduce or eliminate the number of dolphins that are killed incidental to the fishery. Thirty-eight people participated in the workshop (Appendix 1). The agenda for the workshop is given in Appendix 2.

Introductory remarks were given by the Assistant Administrator for NOAA' s Fisheries Service, James Brennan. Brennan noted that it was likely that the legislation that would serve to reauthorize the Marine Mammal Protection Act would direct the Service to submit a plan to Congress for the development and implementation of alternate fishing techniques that would cause a reduction or the elimination of dolphin mortality incidental to purse-seining for tunas in the eastern tropical Pacific (ETP). This plan should be completed by December 1990 and should incorporate the recommendations of an independent review conducted by the National Academy of Sciences. Therefore, the original objectives of this workshop were expanded to include the preparation of an outline for a Memorandum of Understanding (MOU) that could serve as a base document in the initial negotiations between NAS and the Service (Appendix 3).

Brennan further noted that two previous workshops had concluded that economic incentives to use alternatives to setting on porpoise currently did not exist, but that there was insufficient information to identify or evaluate alternative methods of fishing for tunas in the ETP. Finally, Brennan commented that alternative techniques could be organized in four general categories.

1. Modify existing purse-seining techniques, where dolphins are encircled.
2. Develop techniques to separate tunas and dolphins before they are encircled.
3. Develop techniques to locate tunas not associated with dolphins.
4. Develop techniques other than purse-seining for tunas.

There was some discussion about the suitability of spending much time on discussion of category 1. Some participants felt that

Congress' intent in having the Service look at alternative fishing techniques was to concentrate on "new" technologies.

Gary Smith commented that the NAS review would likely use the current techniques of purse-seining as a standard in their review and that some discussion of modifying existing techniques would be useful in that context. He added that under the proposed legislation for the reauthorization of the MMPA, the Service would require the U.S. fleet (and part of the non-U.S. fleet indirectly through importation regulations) to modify the existing purse-seining technique in a number of ways to reduce dolphin mortality. A number of workshop participants felt that the most likely way to reduce dolphin mortality in the immediate future was to modify existing purse-seine technology. The participants agreed that they would concentrate their discussions on categories 2, 3 and 4, and if time permitted, would discuss ideas concerning category 1.

II. New Technologies

The discussion of alternative techniques began with two short presentations; one on recent success with paired trawls for albacore in the Atlantic and the other on recent developments in Fish Aggregating Devices (FADs). J. Paul George reviewed the recent history of the albacore fleet in France. It has been declining since 1966 from a peak of 546 boats to a current low of 53 boats. The fleet had historically used single-vessel trawling gear, but had recently experimented with drift nets. In 1987 a pelagic trawl was used by one boat. The reported catch rate was 6-7 mt per night. In July of 1988, a paired-trawl was used for the first time. Catch rates per week averaged 35-40 mt. The maximum catch in one day was 30 mt. In all cases, the quality of the fish, which was stored on ice after being gutted and bled, was reported to be very good. The trawl was described as having a vertical opening of 50 m, a horizontal opening of 65 m, and was approximately 175 m in length. The trawl was fished at night and towed at 4 to 5 knots. The bottom of the net fished at 20 m. A summary article describing the trawl was distributed to panel members. George reported that one dolphin was incidentally drown in 5 weeks of fishing with this gear. He added that a Danish Company was currently using this technology in the Indian Ocean to catch yellowfin tuna and that he would be glad to provide anyone with information about their success upon their return.

August Felando commented that in the ETP tuna fishery, purse seiners experience substantially higher catch rates than those reported by the pair-trawlers in the Bay of Biscay. Refrigeration needs for albacore tuna caught by the pair-trawlers are substantially different than the requirements of purse seiners engaged in the tropical tuna fishery of the ETP. Albacore do not generally school in dense concentrations, while behavior of yellowfin tuna is to generally school in dense

concentrations while traveling. Martin Hall commented that additional research on the schooling behavior of yellowfin tuna, both during the day and night, was important in the evaluation of this technique. From his studies on yellowfin in the ETP, he speculated that schools of small yellowfin tuna remain intact throughout the day, but that the schooling behavior of large yellowfin tuna was likely to be different. Very little is known about the nocturnal behavior of either small or large yellowfin tuna. Felando noted that it was possible that the tuna-dolphin bond may be weaker at night than during the day and that perhaps this could be taken advantage of in trying to separate tuna and dolphins.

Greg McIntosh led the discussion on recent developments in Fish Aggregating Devices (FADs). In the past, the Service has experimented with FADs that were relatively large (i.e., over one ton) and expensive (i.e., $10,000 per unit). Most of this research was done near and around the Hawaiian Islands, where the FADs were anchored. Loss rates were high. However, catch rates for hook-and-line and long-line fisheries generally were greater in the vicinity of the FADs. In addition, IATTC has experimented with the use of anchored FADs in the ETP to enhance the catch rates of large yellowfin tuna (See working paper #2). They concluded that anchored FADs were not cost effective in the ETP. McIntosh described a new type of FAD that was anchored, was relatively small, and inexpensive (i.e., cost per unit of $130 to $1000). These FADs fish 60 m below the surface and subsequently have a much lower loss rate than surface FADs. Over 4,000 of these devices have been deployed around the world. In the Atlantic, such devices have increase the catch rates of tunas by 50% within a 0.5 miles of the FAD. In the Azores, approximately 5-10 tons of skipjack per day are landed in the pole-and-line fishery off FADs.

The group concluded that it was critical in discussing the utility of FADs in contributing to the development of alternative fishing techniques for tunas in the ETP that anchored and drifting FADs be discussed separately. This was to be noted in the outline for the MOU. Research on the possible development of expendable anchored-FADs or drifting FADs that could be set on by a purse-seiner was discussed. It was noted that drifting FADs would require a satellite positioning device (i.e., a satellite "tag") and a radio beacon to be of much use to the fishermen. Anchored FADs would likely require radio beacons to be of use. It was also suggested that some type of acoustic device could be linked to either the radio beacon or satellite tag to provide information on the presence of either prey or tunas beneath the FAD. Research on acoustic techniques for identifying tunas was recommended by the participants. In

addition, the behavior of tunas and dolphins around FADs was recommended as a research topic.

Kim Holland noted that it was not reasonable to extrapolate from experience with FADs used around the Philippine Islands to the ETP because the Philippine Islands are a spawning area for many of the ETP. Frank Alverson noted that the average depth of the ETP fishing grounds was 5000 - 6000 m and that this might present a technical problem in anchoring FADs. McIntosh reported that small FADs had been developed for deployment in water depths of 6000m. Martin Hall commented that if expendable, drifting FADs were deployed that the consequences of this "debris" in the ocean must be considered. It was generally recognized that yellowfin tuna caught around FADs tended to be smaller than the average yellowfin tuna caught in association with a school of dolphins. It was further noted that the larger tunas tended to be found deeper in the water column than smaller tunas. Felando noted that at present, tuna fishermen in catching the large tunas associated with dolphins in the ETP were achieving a desired management objective of the IATTC, namely catching tuna of a size that results in a high yield per recruit.

There was little discussion on the effectiveness of long-lines in catching tunas in the ETP. It was noted that along the east coast, 50 lb tunas were regularly caught- a size that is comparable with the size yellowfin tuna caught in association with dolphins in the ETP. A number of participants felt that using long-lines in combination with FADs had potential. It was noted that most of the tunas caught in the Pacific by the Japanese fleet with long-lines were targeted for the fresh-fish market and not the canned market, as were tuna caught by purse-seiners in the ETP.

Paul Fiedler then summarized the current capabilities of satellite imagery and how these might relate to the ETP tuna fishery. Basically, remote sensing tools were not available that could direct fishermen to a schools of tuna or dolphin. However, satellite imagery was being currently used to identify areas where the probability of finding target schools was higher than average. As an example, many of the Japanese vessels that long-line for tunas in the central Pacific monitor sea-surface temperature via satellites. These systems cost approximately $35,000. Information from remote sensing satellites has also been used by U.S. albacore fishermen of the west coast of the U.S. The ETP was noted as being an area that has extensive cloud cover for much of the year, which would preclude the use of most of the sensors on satellites currently in orbit. The group agreed that research on factors that affect the distribution of large yellowfin tuna which are not associated with dolphins is needed. Ideally, the environmental data used in this analysis could be collected via

satellite. It is likely that the position of surface and subsurface fronts, which can accumulate prey, and the depth of the thermocline would be related to the distribution of large yellowfin tuna.

There was little discussion concerning the capabilities of long range side-scanning sonar. It was noted that in the ETP, tuna fishermen seek certain bird activity because these birds are associated with the presence of tuna and dolphins. Generally, tuna are not found in association with dolphin schools that are not associated with birds. U.S. tuna seiners have been using modified radar equipment to detect birds for many years. Recent improvements by radar equipment manufacturers have increased the distance of detection. Hall added that the Japanese are also using this technology to locate bird flocks at a distance of up to 24 km. If tuna could be located in this fashion, that were not associated with dolphins, it may be possible to use existing technology to achieve a significant reduction in dolphin mortality.

III. Results of two previous workshops on alternate methods.

Douglas DeMaster distributed two handouts that summarized the conclusions of participants from the two most recent workshops on alternate methods of fishing for tunas in the ETP (Appendix 4). Participants of the 1981 workshop (See working paper #1) concluded that an economically reliable alternative to setting on dolphins currently does not exist and that there may be viable alternatives, but that there was insufficient information to evaluate these alternatives. The panel members reported that the existing methods of purse-seining for tunas by encircling dolphins will be difficult to improve upon in terms of dolphin mortality and recommended that research on ways to locate large yellowfin tuna that are not associated with dolphins and research on ways to separate tuna and dolphins prior to encirclement were needed.

Participants of the 1986 workshop (See working paper #3) agreed with the conclusions from the 1981 workshop. The workshop participants recommended that additional research on the tuna- dolphin bond was needed before methods to separate tuna and dolphins could be developed. They noted that the following recent developments should be monitored as to how they might be used in the ETP: the use of FADs in tropical waters, the development of a long-line tuna fishery in the Atlantic, and the development of a purse-seine fishery for tuna in the western Pacific, where dolphins and tuna do not associate.

IV. Additional research

A number of participants noted that in the review performed by NAS, they should be aware of a few recent publications. First, an FAO Technical Paper (#277) on the dynamics of tuna movements by John R. Hunter et al.. Second, a paper by Jean-Michel Stretta titled, "Forecasting tuna fisheries areas: What parameters, what models? The Praxeological response". This paper was presented at a meeting in Shimizu, Japan in October 1988. Finally, a technical article by George and Brest on paired trawls is available from IFEMER Inc., France.

Felando suggested that in the process of evaluating long-lining for tunas in the ETP, the by-catch issue must be addressed. Wil Sidel commented that reports of incidental catch of turtles by long-line gear has been observed in the Gulf of Mexico. Felando noted rising concern in this country against the use of long-lines. In general, participants agreed that any new technology should do at least as well as purse-seines in terms of by-catch.

Alverson noted that in the ETP, long-lines have been used to catch large tunas, but that these are mostly deep schooling species, like big-eye tuna. Felando commented that tunas caught on long-lines are generally targeted for the fresh fish market. Handling time for these fish is considerably greater than it is for purse-seined fish because the former must be bled and gutted and then frozen at 50 degrees F.

McIntosh suggested that it was unlikely that long-line fishing for tunas could ever produce the volume produced from purse-seining, but that it may be possible to develop new markets for fresh fish. This might reduce the total number of sets on dolphins per year, but the effect would likely be marginal. John Hall noted that if alternative markets, such as the fresh fish market, could be developed, it might be profitable to catch smaller yellowfin tuna or other species of tunas that do not bring top value in the canned tuna market. Furthermore, under certain market conditions, it might be profitable to catch fewer of the large yellowfin tuna than currently caught for the canned fish market, which may lessen the impact of the tuna fishery on dolphin populations.

Martin Hall recommended that additional research on temporal changes in the size composition of tunas around logs was needed. He noted that IATTC had started to collect data on tuna found in association with logs from observers on tuna vessels. However, these observations did not usually follow the same log for a long enough time period to provide conclusive results. It was pointed out that log fishing areas and dolphin fishing areas are quite distinct

spatially. However, logs are reported as being observed in the dolphin fishing areas. The group agreed that if FADs were ever to be of use in catching large yellowfin tuna, data from a long time series of observations around FADs would be required. In addition, an analysis of the size composition of tunas around FADs and logs should be conducted to determine if any features relative to the log or FAD could be correlated with the size of tuna. Richard Brock and McIntosh suggested that subsurface FADs should be considered as a means of aggregating large tunas. These subsurface FADs could possibly be used in combination with purse-seines or other gear that would not entail encircling dolphins.

It was also pointed out that the year to year variability in the proportion of total sets which are on dolphins is large. Alverson noted that in 1986 over 95% of the sets were on dolphins, while in 1988, at least through September, only 59% of the sets were on dolphins. The group agreed that the environmental factors that are associated with these changes should be identified.

The group briefly discussed the potential of mariculture in rearing large tuna for commercial markets. Holland noted that tunas up to 100 lb had been reared at Kewalo Basin, HA. He also noted that skipjack are harder to rear in captivity than yellowfin tuna. The Japanese have reared some species of tunas in ocean-floating pens. However, in general tuna are very susceptible to bruising, which is a problem when then are reared inside of the confines of a net. The group concurred that this approach to meeting the demands of the canned tuna market was of little use.

The use of acoustics to either detect tuna or to separate tunas from dolphins had been discussed superficially throughout the day. John Hall noted that Hubbs Marine Research Institute had experimented with a towed acoustic array of hydrophones to locate tunas and dolphins. The results were not encouraging and the research was discontinued. Hui reported that there was information on the sensitivity of dolphin hearing over a wide frequency range, but that there was no research on how acoustics could be used to cause tuna and dolphins to separate. Acoustic pingers have been developed for the marine environment, but it is not clear how they could be used and if used, if they would not cause an increase in dolphin mortality by causing additional stress to the animals. Felando commented that seal control devices have been used by tuna fishermen to drive dolphins towards the backdown channel prior to backdown. Steve Swartz noted that large whales will avoid novel sounds and the sounds of certain predators (i.e., killer whales), but that the use of sound to separate tuna and dolphins after encirclement could

easily lead to higher rates of mortality. George reported that in New Zealand the fishermen broadcast the sounds made by schooling species of prey to attract tuna. In general the group concluded that acoustic approaches to separating tuna and dolphins were unlikely to produce significant results in the near future. It was noted that the acoustic environment during a purse-seine set should be described more thoroughly as there may be ways to reduce mortality by reducing certain types of sounds or noise levels in general.

It was noted by some of the participants that it may be easier to find tuna not associated with dolphins at night than during the day. However, techniques for locating tunas without the usual visual cues have not been developed. Again, the possible development of acoustic techniques for locating tunas in combination with vessel positioning relative to satellite imagery was considered a reasonable area for future research. In addition, workshop participants agreed that additional studies on movement patterns of dolphins was necessary in evaluating the potential of separating tuna and dolphins by fishing at night.

V. Criteria for evaluating the potential utility of alternative methods for catching tuna in the ETP.

Alverson and Harold Medina reiterated that fishermen are effectively fishing for dollars. The return on the investment for capital equipment and labor had to be competitive with other commercial enterprises. The group agreed that one of the criteria in evaluating the potential utility of alternative fishing methods was the return on the investment and the ability to make a net profit. Holland recommended that the NAS review, when it was considering the use of FADs in combination with acapture technique, should detail the information required to determine the percent of FADs that could be expected to carry commercially acceptable tunas, the volume and size composition of these tunas, the number of FADs and cost per FAD that would be required to service at least the U.S. fleet, and the effect of removing these size and age classes on the tuna stocks that are being affected. In addition, a number of participants were concerned about establishing a protocol for behavior by fishermen around FADs.

Robert Hofman raised the point that Congress will likely want to know the effect on the tuna industry and on the U.S. consumer of not allowing the setting on dolphins in the process of fishing for tunas. Furthermore, Hofman stated that the burden of demonstrating that no alternatives to encircling dolphins exists may shift to the industry. This issue should be addressed in the NAS review. Tom Lewis suggested that the NAS review should consider how the canneries set their prices on tuna by size and species (See Appendix 5). He noted that the percent of sets on

dolphins may be inversely proportional to the price per ton of skipjack (note: dolphins do not generally associate with schools of skipjack tuna). That is, in years when skipjack tuna bring a relatively high price per ton, the percentage of sets on dolphins would decline. Medina noted that when he was fishing (i.e., up to 1985) he never passed up a school of skipjack for yellowfin. Alverson commented that more recently some skippers have not set on schools of skipjack because of the relatively low price per ton.

Chris Croft noted that if dolphins were responding to being set on with purse-seines in such a way that over time it would become more and more difficult to fish for tunas in this way, it would be to the industry's advantage to develop alternative methods of fishing. Martin Hall responded that observer data do not support this hypothesis. That is, the percent of successful sets on dolphins (i.e. , sets where at least one ton of tuna were landed) has varied between 89% to 96% between 1978 and 1986 with no significant trends in the data. Likewise, the average length of time spent chasing a school of dolphins has varied between 0.50 and 0.57 hours between 1979 and 1987. Again, the trend in average chase time over time was not significant.

Martin Hall wanted it noted that NAS in its review should consider the international nature of the problem and the need to develop cooperative research projects. Croft suggested that NAS consider a marketing approach in creating incentives for alternate fishing techniques by possibly labelling canned tuna as to where the tuna were caught or whether they were caught in association with dolphins.

The group also agreed that the cost of any research required to provide information necessary to evaluate any alternate fishing methods must be some reasonable fraction of the gross costs of implementing a new technology. However, it was further noted that it was difficult to assign a meaningful economic value to reducing dolphin mortality. NAS should try to factor in the general public's willingness to either pay more for tuna that are not caught on dolphins or that are caught with methods that are not as efficient as purse-seining for tunas associated with dolphins. Barbara Britten noted that from her experience, the time constraints placed on NAS were unrealistic. Furthermore, the group concluded that because of likely budget constraints the NAS contract may have to be limited in scope, in which case NAS should only be asked to address those alternative methods of fishing that hold the most promise.

Workshop participants agreed that the NAS review should identify the research that is needed to evaluate the potential of alternative methods, the cost of this research and the time required to conduct this research. The Service will then be able

to integrate this list of research areas, as possible, into its existing budget structure.

VI. Conclusions

The workshop participants unanimously agreed that at this time there is no single alternative which the tuna industry finds acceptable as a replacement for the encirclement of dolphins in the pursuit of tunas in the ETP. However, it was further agreed that it was not possible at this time to evaluate the potential of a number of alternative approaches because of a lack of information. If alternatives are to be developed, they are likely to involve the combined utilization of Fish-Aggregating-Devices, tuna capturing techniques that do not involve encircling dolphins, remote sensing, and new markets or marketing procedures for tunas. Workshop participants recognized that members of the purse-seine tuna fishery industry will continue to strive to make technical and methodological improvements that will reduce dolphin mortality. However, it is clear that if dolphins are continued to be encircled by purse-seine gear in the process of catching tuna, dolphin mortality is as unavoidable as gear malfunctions or net collapse.

A summary of alternative methods which were considered to have potential in reducing dolphin mortality is in Table 1. A summary of research needed to evaluate these alternative methods is given in Table 2. The critical piece that seems to be necessary in developing a technology that does not involve encircling dolphins with a net is the ability to locate schools of large commercially valuable tuna that are not in association with dolphins, if there are such schools. Two approaches were identified that will require additional research: 1) research on the feasibility of using FADs to aggregate commercially valuable tuna and 2) research on the feasibility of located commercially valuable tuna that are not in association with dolphins. Both of these approaches are dependent on the ability to catch tuna that are not in association with dolphins.

Table 1. Summary of methods which were considered to have potential in offering technical and economically feasible methods of catching yellowfin tuna in the ETP.

I. Purse seine technology
  a. Develop technology to separate tuna and porpoise prior to encirclement
    1. visual stimulation
    2. Acoustic stimulation
    3. Olfactory stimulation 4. Combination of 1, 2 and 3.
  b. Develop technology to locate tuna not associated with porpoise
    1. Satellite mapping
    2. Long-range sonar
    3. FADs (drifting and anchored)
II. Non-purse seine technology
  a. FADs (drifting and anchored) used with trawls, long-lines, etc
  b. Long-lines
  c. Paired Trawl gear
  d. Satellite mapping with trawls, long-line, etc

Table 2. Summary of research needed to evaluate the potential of alternative methods for catching yellowfin tuna in the ETP.

I. Predicting distribution of large yellowfin tuna in ETP
II. Understanding bond between large yellowfin tuna and dolphins

III. Development of acoustic detection and survey techniques for yellowfin tuna
IV. Development of passive acoustic techniques to locate tunas
V. Evaluation and development of additional markets and marketing strategies for tunas, including fresh fish and flash freezing
VI. Research on "natural" FADs (i.e., logs) and ways to aggregate large tunas

Appendix 1.

WORKSHOP PARTICIPANTS

NAME	ADDRESS
Frank Alverson	Living Marine Resources, Inc. 11855 Sorrento Valley Rd. , Suite A, San Diego, CA 92121-1028
Izadore Barrett	SWFC, P.O. Box 271, La Jolla, CA 92038
Hannah Bernard	Greenpeace, 2688 Burgundy Rd., Arcadia, CA 92024
David Bratten	IATTC/c/o Scripps Institution of Oceanography, La Jolla, CA 92038
Jim Brennan	NMFS, 1335 East-West Highway, Room 9334, Silver Spring, MD 20910
Barbara Britten	American Cetacean Society, 1300 S. Arlington Ridge Rd., #614, Arlington, VA 22202
Richard Brock	University of Hawaii at Manoa, Kaneohe, HI 96744-1346
Jim Coe	NMFS, Northwest and Alaska Center, 7600 Sand Point Way, N.E. Seattle, WA 98115
Damaso Luna Corona	Direccion General de Asuntos Pesqueros Internacionales, Secretaria Pesca, Mexico
Chris Croft	c/o Greenpeace, 1436 U Street, N.W. Washington, D.C. 20009
Douglas P. DeMaster	SWFC, P.O. Box 271, La Jolla, CA 92038
Michel Dreyfus	INP (CRIP), Ensenada, B.C., Mexico
Elizabeth Edwards	SWFC, P.O. Box 271, La Jolla, CA 92038
Michel G. Esperanza	Marine Mammal Program, (CRIP) KM 1. Carretera a pichilingue, La Paz, B.C.S. Mexico CP 23000

Appendix 1. WORKSHOP PARTICIPANTS (continued)

NAME	ADDRESS
August Felando	General Manager, American Tunaboat Association, 1 Tuna Lane, San Diego, CA 92101
Paul Fiedler	SWFC, P.O. Box 271, La Jolla, CA 92038
Luis Fleischer	Marine Mammal Program, (CRIP) KM 1. Carretera a pichilingue, La Paz, B.C.S. Mexico CP 23000
Charles Fullerton	Southwest Region, 300 S. Ferry St., Room 2005, Terminal Island, CA 90731
J. Paul George	IFREMER, Centre de Brest, BP 70, 29263 Plouzane, France
John Hall	Hubbs Research Center, 1700 South Shores Rd., San Diego, CA 92109
Martin A. Hall	IATTC c/o Scripps Institute of Oceanography, La Jolla, CA 92093
Robert Hofman	Marine Mammal Commission, 1625 Eye St., N.W. Washington, D.C. 20006
Kim Holland	Hawaii Institute Marine Biology, University of Hawaii - Manoa, Honolulu, HI 96822
Clifford Hui	Code 521, NOSC, San Diego, CA 92152-5000
Charles Karnella	NMFS, 1335 East-West Highway, Room 8254 Silver Spring, MD 20910
Tom Lewis	American Cetacean Society, 1300 S. Arlington Ridge Rd., #614, Arlington, VA 22202
Greg MacIntosh	McIntosh Marine, Inc., 2600 Southeast 17th Street, Suite 378, Ft. Lauderdale, FL 33316
Harold Medina	5022 Bluff Pl., El Cajon, CA 20036

Appendix 1. WORKSHOP PARTICIPANTS (continued)

NAME	ADDRESS
Norman A. Mendes	Tuna/Porpoise Management Branch, Field Office, Southwest Region, 2520 State St., Suite 200, San Diego, CA 92101-2983
David Phillips	Earth Island Institute, 300 Broadway, Suite 28, San Francisco, CA 94133
Stephen B. Reilly	SWFC, P.O. Box 271, La Jolla, CA 92038
Humberto Robles	INP (CRIP), Ensenada, B.C., Mexico
Barbara Rothschild	1335 East-West Highway, Room 7270, Silver Spring, MD 20910
Robert Salomons	Porpoise Rescue Foundation, c/o Living Marine Research (LMRFR), 11855 Sorrento Valley Road, Suite A, San Diego, CA 92121-1028
Wil Seidel	NMFS, Pascagoula Facility, 3209 Frederic Street, Pascagoula, MS 39567
Gary Smith	Southwest Region, 300 S. Ferry St., Terminal Island, CA 90731
Steven L. Swartz	Center for Environmental Education, 1725 DeSales, N.W., Washington, D.C. 20036
John Young	Tuna/Porpoise Management Branch, Field Office, Southwest Region, 2520 State St., Suite 200, San Diego, CA 92101-2983

Appendix 2.

Draft Agenda
Southwest Fisheries Center
11-12 October 1988
Large Auditorium

1. 0900 11 October- Introductions (Barrett)
   - Review and update of issues (Brennan)
   - Management decision process (Fullerton)

2. 0930 11 October- Identification of alternative fishing methods.

3. 1330 11 October- Discussion on best way to evaluate alternative methods and establish criteria that could be used to evaluate any proposals.

4. 1500 11 October- Identification of existing gaps in available information needed to evaluate alternative fishing methods.

5. 0900 12 October- Discussion of best way to prioritize research programs directed at providing information needs.

6. 1000 12 October- Prioritize research programs previously identified.

7. 1330 12 October- Summary (Barrett)

Working Papers Distributed to All Participants:

1. NMFS. 1986. A review on procedures to develop alternatives to tuna purse seining on porpoise. (Summary of conclusions reached by a panel of experts that met in April 1986).
2. Bratten, D.A. 1983. Reducing dolphin mortality incidental to purse-seining for tunas in the eastern Pacific Ocean: A Review of the tuna-dolphin fishing gear program of the Inter-American Tropical Tuna Commission. Rep. Int. Whal. Commn 33:599-602.
3. Hofman, R.J. 1981. Identification and assessment of possible alternative methods for catching yellowfin tuna. National Technical Information Service PB83-138933. 139 pp. (Report based on a meeting held at Hubbs Sea World Research Institute in May 1981).
4. Alverson, F. 1988. Background to alternative fishing methods for yellowfin/porpoise aggregations. Unpub. manuscript. 4pp.

Appendix 3.

DRAFT OUTLINE
Memorandum of Understanding between
the National Marine Fisheries Service and the
National Academy of Sciences

I. Background
   a. Nature of problem (mortality and serious injury of porpoise due to practice of setting on porpoise)
   b. Steps that have been taken to modify fishing gear and practices to avoid and reduce porpoise mortality
      1. Backdown
      2. Medina panel
      3. Skippers panel
   c. Steps that have been taken to identify and evaluate possible alternatives to setting on porpoise
      1. Feb 1977 workshop
      2. Dedicated vessel program
      3. NSF/RANN supported research
      4. 1981 workshop
      5. Subsequent NMFS research
      6. 1984 amendments to MMPA
      7. April 1986 workshop
      8. 1988 amendments to MMPA and workshop

II. Study objectives
   a. Define the known and possible biological and economic consequences of catching yellowfin tuna of different sizes
   b. Identify potential cost-effective alternatives to the practice of setting on porpoise to catch large yellowfin tuna found in association with porpoise schools in the ETP (Table 1) or the types of research that would be necessary to develop such alternative methods (Table 2)
   c. Describe the types of simulation, laboratory, engineering, field and/or other studies that would be required to evaluate the cost effectiveness of the possible alternatives identified
   d. Estimate the time, money, special logistic support, equipment etc. that would be required to do the identified studies; and
   e. Rank the identified studies according to the probability that they can be done at reasonable cost and will contribute to developing a cost-effective alternative to setting on porpoise

III. To meet the study objectives, the NAS will:
   a. Compile a review on published and unpublished reports and consult with knowledgeable experts, to obtain the best available information on:
      1. biology and ecology of yellowfin tuna;
      2. biological and economic consequences of catching yellowfin tuna of different sizes, and

3. work that has been done to identify and evaluate the likely cost-effectiveness of possible alternative to setting on porpoise to catch large yellowfin tuna found in association with porpoise;

b. Constitute and convene one or more groups of experts -- including scientist, gear experts, design engineers, and others with relevant expertise including people with no previous involvement in tuna-porpoise related issues -- to:

1. identify possible cost-effective alternatives to the practice of setting on porpoise;

2. describe the types of research that would be required to evaluate the technical and economical effectiveness of the identified alternatives;

3 . estimate the time, money, logistic support, and other resources that would be required to accomplish the identified research;

4 . rank the identified studies according to the apparent probability that they can be done in a reasonable time at reasonable cost and will contribute to the development and implementation of cost-effective alternatives to the practice of setting on porpoise

c. Prepare a report describing the results of tasks IIIa & b

IV. Reporting requirements

a. 30 to 60 days following completion of MOU, NAS will provide the Service list of experts that they intend to consult, a schedule of meetings with these experts, and draft set of criteria that NAS intends to use in evaluating the technical and economical feasibility of any alternative methods for catching yellowfin tuna in the ETP

b. By 15 July 1989 NAS will submit a draft report on the results of tasks IIIa and b.

c. within 30 to 60 days of receiving comments from the Service, NAS will submit a final report on alternative methods of catching yellowfin tuna in the ETP

Summary
Workshop on Identification and Assessment
of Possible Alternative Methods for Catching
Yellowfin tuna

Held at Hubbs Sea World Research Institute
27-28 May 1981

0 Identify ways to separate tuna from porpoise prior to encirclement (e.g., olfactory or auditory stimulation)

0 Detecting and catching yellowfin tuna in the absence of porpoises (e.g., satellite imagery, sonar, towed arrays, FADs)

0 Use of gear other than purse-seines (e.g., bait boats, long-lines, fish traps, gill-nets)

0 Research needs:

1. Develop an improved capability for predicting the location of large schooling yellowfin tuna

2. Identify methods for long-range detection of free ranging and porpoise associated tuna

3. Identify methods for separating tuna from porpoise prior to encirclement

4. Identify methods for aggregating tuna not associated with porpoise

0 Conclusion: an economically reliable alternative to setting on porpoise currently does not exist; there may be viable alternatives; available information is insufficient to identify,' or evaluate alternative methods; additional research will be necessary to evaluate alternative methods

Summary Workshop to Review Procedures to
to Develop Alternatives to Tuna Purse Seining
on Porpoise

Held at Southwest Fisheries Center
April 1986

0 1981 amendments to MMPA required the Secretary of Commerce to undertake a program of, and provide financial assistance for, research into new methods for locating and catching yellowfin tuna. However, specific funds were not appropriated

0 NMFS conducted a review of literature in 1985 published since 1981

0 Workshop participants generally agreed with conclusions of the 1981 workshop

0 The following new deveopments were noted: 1) development of tuna purse seine fishery in the western Pacific, 2) recent research on FADs by SWC, 3) development of a long-line tuna fishery in the eastern north Pacific and western Atlantic

0 Development of remote sensing capability via satellites

0 Development of towed acoustic array for locating tunas and dolphins at Hubbs Research Institute

0 The tuna-porpoise bond must be better understood before alternative techniques are developed

0 Possible alternatives:

1. Modify existing purse seine gear (e.g., lights, backdown boards, net modifications)

2. Separate tuna and porpoise prior to encirclement

3. New technology (e.g., FADs, longlines, long-range sonar)

Appendix 5.

ATSA PRICES*

Effective September 16 - November 30, 1988**

Puerto Rico

	Yellowfin	Skipjack
Over 20 pounds	$1,065	
7.5- 20 pounds	935	$ 900
4.0-7.5 pounds	825	825
3.0-4.0 pounds	615	615
Under 3 pounds	340	340

American Samoa

Over 20 pounds	$1,065	
7.5- 20 pounds	920	875
4.0-7.5 pounds	815	815
3.0-4.0 pounds	615	615
Under 3 pounds	340	340

* Per Bill Gillis ATSA

**Departure date